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PETROLOGICAL ABSTRACTS AND REVIEWS

ALBERT JOHANNSSEN

BOWEN, N. L. "The Crystallization of Haplobasaltic, Haplodioritic and Related Magmas," *Amer. Jour. Sci.*, XL (1915), 161-85.

The terms haplobasaltic, haplodioritic, and so on, are applied by the writer to simple (pure) artificial mixtures of feldspars of various compositions, and diopside. He uses the rock names according to the best and most recent practice. Various mixtures of these substances were studied by the quenching method of thermal analysis, that is, by sudden chilling at known temperatures, and the material was studied microscopically. No attempts were made to study the optical properties of the minerals formed, it being necessary only to distinguish diopside from plagioclase in these experiments, the results of which are plotted in numerous diagrams. From his results the writer concluded that crystallization controls differentiation in the subalkaline igneous rocks.

BOWEN, N. L., and ANDERSEN, OLAF. "The Binary System MgO-SiO₂," *Amer. Jour. Sci.*, XXXVII (1914), 487-500.

A study of equilibrium in the binary system MgO-SiO₂ by the method of quenching. Forsterite (Mg₂SiO₄) and clinoenstatite (MgSiO₃) were found capable of existing in contact with liquid in the binary system. Clinoenstatite was the only stable form of MgSiO₃ found. It has no true melting-point, but at 1,557° breaks up into forsterite and liquid. At 1,577° the forsterite dissolves. There is no eutectic between these two compounds.

BOWEN, N. L. "The Ternary System Diopside-Forsterite-Silica," *Amer. Jour. Sci.*, XXXVIII (1914), 207-64.

An investigation of various mixtures of silica, calcium carbonate, and magnesia. It was found that the systems diopside-silica and diopside-forsterite show the simple eutectic relations; forsterite-silica shows one intermediate compound (clinoenstatite) unstable at its melting-point; and clinoenstatite-diopside forms an unbroken series of solid

solutions, corresponding to the monoclinic pyroxenes. The triangular diagram, therefore, shows only three boundary curves and one ternary invariant point. The writer shows that crystallization may proceed according to two different methods, and the importance of distinguishing between them is discussed. The optical properties of the pyroxenes are discussed at some length; extinction angles, refractive indices, and optic axial angles are measured and the orientation is determined.

BOWEN, N. L. "Crystallization-Differentiation in Silicate Liquids," *Amer. Jour. Sci.*, XXXIX (1915), 175-91.

Laboratory experiments showed that olivine and pyroxene crystals sink and tridymite floats in artificial melts of diopside, forsterite, and silica. From the rate of sinking, the viscosities of the melts were found to increase with increase in silica.

COLLINGBRIDGE, HARVEY. "The Determination of the Maximum Extinction Angle, Optic Axial Angle, and Birefringence in Twinned Crystals of Monoclinic Pyroxenes in Thin Section by the Becke Method," *Mineralog. Mag.*, XVII (1914), 147-49.

Gives a method for determining various optic properties by observations on twinned crystals which show the emergence of an optic axis in one portion.

COLLINS, W. H. *The Huronian Formations of Timiskaming Region, Canada*. Museum Bull. No. VIII, Geol. Surv., Dept. Mines, Canada. Ottawa, 1914. Pp. 27, figs. 3, pls. 1.

CROSS, WHITMAN. *Lavas of Hawaii and Their Relations*. U.S. Geol. Surv., Prof. Paper 88, Washington, 1915. Pp. 97, map 1, pls. 2, fig. 1, bibliography.

The writer describes, with considerable space devoted to the norms, various olivine-bearing and olivine-free-, bronzite-, picrolitic-, nephelite-, and mellilite-nephelite-basalts, limburgites, soda-trachytes, trachyandesites, a kauaiite or oligoclase-augite-diorite, some basalt tuffs, and a

gabbro. Forty-three chemical analyses are given, and in most cases the normative minerals are computed. In the general discussion the characteristics, chemical compositions, normative compositions, the relations of norms to modes, and the classification are considered. Twenty-two pages are devoted to the distribution of the rocks in the Hawaiian Islands and of analogous rocks elsewhere in the world. The writer discusses the Atlantic and Pacific provinces, and the alkalic and calcic series (alkali and alkali-lime series of Rosenbusch), and concludes with a discussion of differentiation in the Hawaiian magmas.

CROSS, WHITMAN. "On Certain Points in Petrographic Classification," *Amer. Jour. Sci.*, XXXIX (1915), 657-61.

An answer to several criticisms of the C.I.P.W. system of rock classification.

DALMER, K. *Erläuterungen zur geologischen Spezialkarte des Königreichs Sachsen*. Sektion Treuen-Herlasgrün, Blatt 134. 2d ed. revised by E. Weise and A. Uhlemann. Leipzig, 1913. Pp. 58, pl. 1.

Picrite, diabase, granite, quartz-porphyry, mica-porphyrity, various contact metamorphosed schists, and sediments are described.

DALY, REGINALD A. *Origin of the Iron Ores at Kiruna*. Vetensk. och Prakt. Undersök. i Lappland. Stockholm, 1915. Pp. 35, figs. 4.

Expresses the view that the "inclusions" of ore in the Kiruna quartz-porphyry, are endogenous, and represent "frozen-in" units of differentiation. The accumulation of such ore-masses by gravity is thought to be the cause for the origin of the main ore bodies.

DALY, REGINALD A. *Geology of the North American Cordillera at the Forty-Ninth Parallel*. Mem. 38, Dept. Mines. Ottawa, 1912. Pp. 840, maps 17, pls. 73, figs. 42.

— Although the date on the title-page of this important memoir is 1912, and the date of transmission 1910, it was not distributed until 1914. In the meantime Daly's *Igneous Rocks and Their Origin*, which contains a much fuller statement of the theories expressed in chaps.

xxiv to xxviii, appeared. It is almost impossible in the space available here, to abstract a book of this character. The Table of Contents alone covers 15 pages, and a synopsis given by the author 8 pages.

After describing the area covered, the author shows the various subdivisions into which the Cordilleras have been divided, and suggests various additions and changes. Then follow descriptions of the stratigraphy and structure of the Clarke, MacDonald, Galton, Purcell, and Selkirk mountain systems, and the Rossland, Christina, Midway, Okanagan, Hozomeen, Skagit, and other ranges. In chaps. ix to x the Purcell lava and associated intrusives are described. The differentiation in the Moyie sill is ascribed to the assimilation of quartzites, and the writer offers proof of this as well as of gravitative differentiation. A great number of chemical analyses are presented. The descriptions of the rocks are given in a manner which might well be followed by other petrologists, namely that of giving the mode of the rock as well as the norm. Further, it is advisable, as is here done, to indicate whether the mode was determined by the Rosiwal method, or by recalculation of the analysis and comparison with the thin section. Pages 677 to 791 are mostly theoretical, and deal with the theory of igneous rocks, classification of igneous bodies, mechanics of batholithic intrusion, differentiation, classification of magmas, etc.

The report is unusually interesting, not only in the theoretical part, but also in the descriptive portions, which in most geologic reports have a soporiferous effect.

DALY, REGINALD A. "Problems of the Pacific Islands," *Amer. Jour. Sci.*, XLI (1916), 153-86, pl. 1, figs. 38.

A plea, given at the meeting of the American Association for the Advancement of Science at San Francisco last August, for the establishment of a central bureau for the comprehensive exploration, from a scientific standpoint, of the Pacific Islands. It is estimated that the cost of such a project will be from \$800,000 to \$3,000,000, depending upon the thoroughness of the work, and that it will require about ten years of time for the field work, and an additional five or ten years for systematizing and publishing the results. The writer presents a number of the problems which should be solved.

DRYSDALE, CHARLES W. *Geology of Franklin Mining Camp, British Columbia*. Mem. 56, Geol. Surv., Dept. Mines. Ottawa, 1915. Pp. 246, pls. 23, figs. 16, bibliography.

A report on a mining camp in the Yale District in south-central British Columbia. The Franklin group contains the oldest rocks in the district, consisting of metamorphic tuffs, quartzites, and argillites, the latter carrying Paleozoic fossils. The rocks may represent early marine coastal conditions of sedimentation and igneous activity prior to the submergence and eastward transgression of a Carboniferous sea. At the close of the Paleozoic the main folding and metamorphism of the region took place, and the Franklin District thereafter remained above the sea. During the Jurassic period there came the intrusion of a granodiorite batholith beneath a considerable cover of sediments. It did not reach the surface. The Cretaceous period was one of long-continued denudation, laying bare great thicknesses of Paleozoic rocks and even exposing the underlying Jurassic batholith in places. At the close of the Mesozoic the whole Cordillera was uplifted and the Valhalla granite was probably intruded. The early Tertiary was a period of regional sinking accompanied by some volcanic activity. It closed with the tilting of the Kettle River formation, and a new cycle of erosion started. At this time also there came the intrusion of monzonite. During the Miocene there came intrusions of syenite, followed by pyroxenite and augite-syenite, pulaskite-like dikes, and trachyte flows. Regional uplift closed the Tertiary. During the Pleistocene all except a few of the highest peaks of the Cariboo Range were covered by the Cordilleran ice sheet.

A number of chemical analyses of the igneous rocks are given.

ESKOLA, PENTTI. *On the Petrology of the Orijärvi Region in Southwestern Finland*. Bull. com. géol. Finlande, No. 40. Helsingfors, 1914. Pp. 277, pls. 6, maps 2, figs. 55, bibliography.

This interesting bulletin gives an account of the petrology of a series of Archean metamorphic rocks in the vicinity of Orijärvi. After a short geologic history of the region, the author gives careful and detailed petrographic descriptions of various granites, magmatites, pegmatites, diorites, gabbros, hornblendites, aplites, peridotites, amphibolites, leptites, and limestones. He then describes the exogenic contact-zones of the oligoclase-granite, and gives petrographic determinations of the

cordierite-anthophyllite, quartz-cordierite-, cordierite-, and andalusite-quartz-mica-rocks, cordierite-gneiss, plagioclase-biotite-gneiss, cumingtonite-amphibolite, and the skarn rocks. A great many chemical analyses are given, and they are recomputed into the norm as well as into Osann's system. Further, all analyzed rocks whose mode could be determined under the microscope have been recomputed into the mode, an example which might well be followed by petrographers in this country.

FENNER, CLARENCE N. "The Stability Relations of the Silica Minerals," *Amer. Jour Sci.*, XXXVI (1913), 331-84.

The following inversion-points were determined at atmospheric pressure.

$870^{\circ} \pm 10^{\circ}$ quartz \rightleftharpoons tridymite

$1470^{\circ} \pm 10^{\circ}$ tridymite \rightleftharpoons cristobalite

Velocity of transformation very slow.

α -quartz \rightarrow β -quartz 575°

β -quartz \rightarrow α -quartz 570°

α -tridymite \rightarrow β_1 -tridymite 117°

β_1 -tridymite \rightarrow β_2 -tridymite 163°

α -cristobalite \rightarrow β -cristobalite 274° to 220° , depending upon the previous heat treatment.

β -cristobalite \rightarrow α -cristobalite 240° to 198° , depending upon the previous heat treatment.

The transformation in the last six cases takes place promptly.

The melting-point of cristobalite is *ca.* $1,625^{\circ}$, while quartz is at least 155° lower.

FERMOR, L. LEIGH. "Preliminary Note on Garnet as a Geological Barometer and on an Infra-Plutonic Zone in the Earth's Crust," *Records Geol. Surv., India*, XLIII (1913), 41-47.

A comparison of the specific gravities of certain garnet-bearing rocks with the specific gravities of the same magmas crystallizing in normal minerals showed that the garnet-bearing rocks occupied from 10 to 20 per cent less room. From this the author concludes that garnet-bearing rocks, such as kodurite, eclogite, etc., are high-pressure forms of normal rocks. He therefore postulates the existence, below normal plutonic rocks, of a shell characterized by garnets wherever a sesqui-oxide radicle exists. For this shell he proposes the term "infra-plutonic." Another

mineral of this zone is diamond. Under normal conditions the author thinks a relief of pressure would liquify a certain portion of the infra-plutonic rocks which, on being intruded into the higher zones of the earth's crust, would there solidify under less pressure as a normal plutonic rock. Only under exceptional circumstances, for example when the isogeotherms are lowered more rapidly than the pressure, will the garnet-rock cool in its infra-plutonic form, to appear later by erosion. The author considers this garnet-shell to be continuous around the earth and potentially liquid, subject to local fusion and the formation of reservoirs wherever there is a reduction of superincumbent pressure.

Applying this theory to meteorites, he thinks the chondrules, which occur in so many stony varieties, were formerly garnets, and that cliftonite in the iron meteorites was formerly diamond.

FETTKE, CHARLES REINHARD. "The Manhattan Schist of Southeastern New York State and Its Associated Igneous Rocks," *Ann. N.Y. Acad. Sci.*, XXIII (1914), 193-260, pls. 8, bibliography.

The Manhattan schist, the youngest of the three crystalline metamorphic formations which form bed-rock in southeastern New York, occurs in a series of closely folded anticlines and synclines, usually unsymmetrical and in many cases overturned toward the west. The axes of the folds run northeast and southwest and gently dip to the south. The chemical composition and field-relations of the schist show that it is of sedimentary origin, derived from shales, sandstones, and arkoses. These were laid down conformably upon the underlying limestone to a depth of several thousand feet. Later a series of basic rocks—hornblende- and actinolite-schists of dioritic and gabbroic characteristics, and granodiorite-gneiss (better gneissoid-granodiorite, since it was determined to be of igneous origin)—was intruded in the form of sheets and sills. Now came a period of intense folding accompanied by intrusions of granite, aplite, and pegmatite. Later there were intruded various basic rocks—norites and pyroxenites of the Cortlandt series, hornblendite near Croton Falls, and other rocks now altered to serpentine. The pegmatitic intrusions still continued, for these later basic rocks are cut by them in several places.